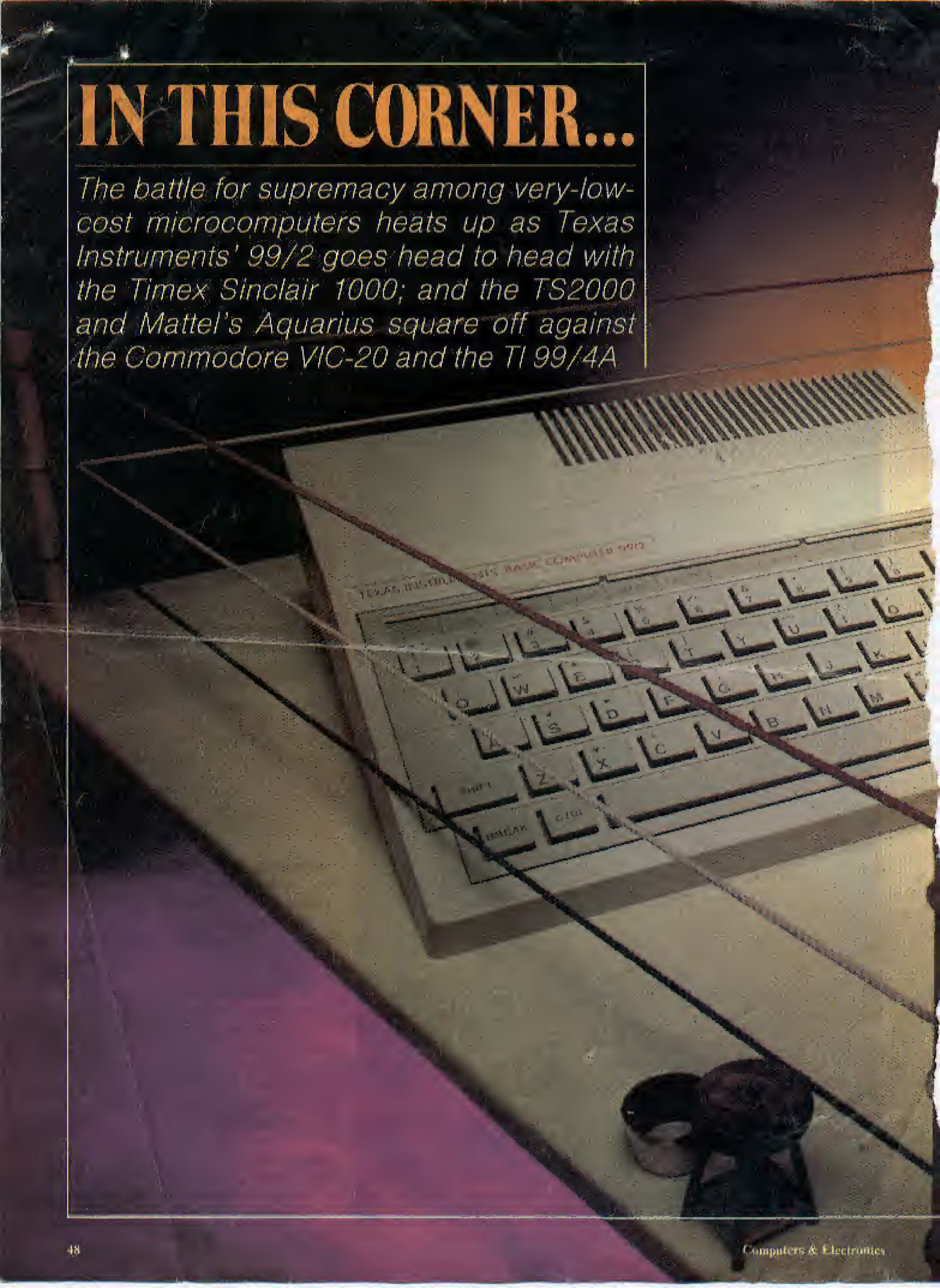
IN THIS CORNER...

The battle for supremacy among very-low-cost microcomputers heats up as Texas Instruments' 99/2 goes head to head with the Timex Sinclair 1000; and the TS2000 and Mattel's Aquarius square off against the Commodore VIC-20 and the TI 99/4A



By Joe Desposito

The microcomputer world, much like the boxing world, has champs and contenders at all different levels. Lately there has been fierce competition at the low end of the microcomputer spectrum with current champs such as the Timex Sinclair 1000, Commodore VIC-20, and Texas Instruments 99/4A facing stern competition from a host of new challengers. Very-low-cost micros can be conveniently classed into two groups: those that cost less than $100 (we'll call them featherweights) and those that cost between $100 and $200 (we'll call them lightweights). Let's review the champs of each of these divisions here and take a close, hard look at the new contenders.

(Continued overleaf)

Featherweight

HEX-BUS peripherals for the Texas Instruments 99/2.

THE clash for the microcomputer "featherweight" crown promises to provide as much excitement as a title bout at Caesar's Palace. The reigning champ, trained in Britain for more than a year before arriving in the States, is the Timex Sinclair 1000 (formerly competing as the ZX81). Although it has some drawbacks, this scrappy performer is the undisputed champ of its division. And undisputed is not used lightly here. Until recently there has not been one challenger in the featherweight (under $100) class.

But a formidable challenger has arrived. Known in some circles as the "Great White Hope" because of its cream-colored appearance, the 99/2 from Texas Instruments seems to have everything it takes to dethrone the current champ. It is bigger, faster, classier looking, and (thank goodness) has a keyboard with movable keys. These obvious strengths, however, do not guarantee success. Sometimes it takes more than impressive stats to become a champ. Sometimes intangibles like guts or heart make the champion (witness Rocky Balboa's comeback win over Clubber Lang).

What are the intangibles the older TS1000 has going for it? First off, this computer is an open book—for a long time it could be bought as a kit under its former name. With so many fans knowing the ins and outs of its makeup, the wealth of support it receives from outside suppliers is not surprising. Peripherals available for use with it include such devices as printers, memory expansion modules, and modems. Keyboards for the TS1000 are being sold to correct its major deficiency, the membrane keyboard. Thousands of business programs, educational programs, and games have been written for the TS1000. Even additional languages such as Forth and Assembler are available through third-party vendors. This humble number cruncher even has a magazine named *Sync* devoted to it. Another point in the TS1000's favor is that it has been the champion for a long time. People are used to it, they love it. On top of all this, it has a secret weapon in its arsenal (which we'll reveal later on in this article).

But enough about the champ; what about the challenger, the TI 99/2? As we said before, this newcomer is impressive looking. It's substantially bigger than the TS1000, measuring in at 10" × 9½" × 1½".

Its elastomeric keyboard sports 48 pushbutton-type keys in a standard typewriter format. Listed above the keyboard are nine functions. To engage one, the FCTN (function) key plus a key on the top row just below the desired function label must be pressed.

The 99/2 only uses upper-case letters and each key has no more than two legends (whereas the TS1000 uses up to five legends on one key). There is a built-in r-f modulator so that the 99/2 can be hooked right to the TV.

The basic unit comes with 4.2K of user RAM. This can be expanded to 36.2K by plugging in extra RAM housed in "cradles" that hold the RAM chips and permit additional cartridges to "piggy-back" on the RAM cradle. The operating system and program are contained in 32K of ROM, of which 24K is in the permanent memory map. The remaining 8K bytes are bank switched to preserve a 32K-byte expansion port capability.

As with most other TI computers, the microprocessor is part of the 9900 family. It's the 16-bit TMS9995 that has a 10.7-MHz clock—mighty fast for this class—and DMA (direct memory access) video processing. The 99/2 has a flicker-free black-and-white display of 27 characters by 24 lines (whereas the TS1000 still flickers in the slow mode). The 99/2 is designed with an operating system that is a subset of TI-BASIC but the system does not support GROMs (Graphics Read Only Memory) or GROM programming language, joysticks, color, sound, or speech (as the

Timex Sinclair 2040 printer works with either TS1000 or TS2000.

FEATHERWEIGHTS AT A GLANCE

	Timex Sinclair 1000	Texas Instruments 99/2
Microprocessor	Z80A (3.5 MHz, 8 bits)	TMS 9995 (10.7 MHz, 16 bits)
Resident language	Sinclair BASIC	TI BASIC subset
Memory: ROM	8K	32K
RAM (Std)	2K	4.2K
RAM (Exp)	64K	36.2K
Text display	32 char. × 24 lines	28 char. × 24 lines
Keyboard	40 keys (membrane)	48 keys (elastomeric, movable)
Dimensions	6½" × 6" × 1½"	10" × 9¼" × 1¼"
Weight	12 oz	33 oz

99/4A does). You may have guessed by now that any program written for the 99/2 is compatible with its big brother, the popular 99/4A. However, this is only a one-way street as software for the big guy won't return the favor.

At the rear of the 99/2 is a port that will accept solid-state software cartridges (not compatible with the 99/4A). But so far there's very little in the way of this kind of support. This port does have a great deal of significance, however. It is the spot where the real power of this featherweight will be displayed.

The 99/2 has a team available for the expansion port that is ultra-sophisticated. This team, known as the HEX-BUS peripherals, will surely be the envy of anyone who owns a computer in this class. Let's take a closer look at this HEX-BUS group, as it may be the key factor in establishing the 99/2 as king of the featherweight class.

First there is the Wafertape™ Drive. Of course, the 99/2 can save to a standard cassette recorder, but the Wafertape adds finesse to the operation. This digital tape drive unit uses continuous-loop tape cartridges that store up to 48K. An ordinary cassette recorder cannot move the tape back and forth and, therefore, it is difficult to use this type of recorder for a true computer-file system. The Wafertape, using a continous loop, can employ a real tape file system with all the programs on the tape listed in a directory. The tape can then be moved to locate any of the named program files. The tape must first be initialized just like a diskette, so the Wafertape system can be thought of as a "stringy floppy." This system is somewhat slower than a floppy disk, but it is much better than the ordinary cassette tape system used in most home computers. A 4K-byte program can be loaded fast—about 10 seconds.

Another power-packed peripheral is a four-color printer/plotter. Ten different type sizes are available, with print speeds up to 11 characters per second. Printing is done on 2¼" paper in either red, blue, green or black.

An RS232 communications interface rounds out the HEX-BUS group. With this handy peripheral, you can interface the 99/2 to an 80-column printer. It also allows you to hook up a modem for communications with real heavyweight computers like those used by CompuServe.

In all fairness we must mention that HEX-BUS support doesn't come cheap. Suggested retail prices for the peripherals are: Wafertape, $139.95; Printer/Plotter, $199.95; and RS232 interface, $99.95 (with parallel interface option, $124.95). But still, the support is there if desired.

What's our opinion of the challenger's chances? At first glance, the 99/2 is certainly impressive. But will it suffer the same fate as the 99/4A, which gets software and hardware support almost exclusively from the parent company? (No cottage industry has blossomed here.) It took many years and many price reductions before the 99/4A was embraced by the general public. Will anyone try to take the 99/2 apart and have some fun with it? A polished featherweight can tarnish quickly waiting in the locker room (inside the locker?) for something exciting to do.

Another factor that has to be considered is the current champ's secret weapon. What is it? The TS1000 has the awesome power to shed price almost at will. At the beginning of 1983, a $15 rebate was announced, evidence enough of this raw power. But then in mid-March, the champ plummeted from $99.95 to $69.95, and kept the rebate going, too. What all this means is that the champ may eventually establish a new class—a "flyweight" division at less than $50. Can TI's 99/2 meet this challenge? Our guess is that the 99/2 has enough class to make a strong showing, but not enough to dethrone the champ. But this will also be influenced by promotional money behind it.

Lightweight

THE "lightweight" division (between $100 and $200) had just two brawlers during 1982, the Commodore VIC-20 and Texas Instruments 99/4A. The Commodore VIC-20 is a true champion that offers a real moving-key keyboard, excellent memory-expansion capability, a host of low-cost peripherals, and a vast library of programs on cartridges, tapes, and disks. The VIC-20's price has shrunk to less than $140 in some stores, a value that is hard to beat. Last year the Commodore management wanted to replace VIC with a new entry in its stable named MAX. However, the public would not stand for it; and now it is learned that MAX will only appear in Far East events.

The 99/4A from Texas Instruments originally sold for more than $1000. The machine has been improved, and the price lowered to less than $150 by eliminating the color monitor and utilizing mass production. The 99/4A offers an upward expansion path to a full disk system and a vast library of cartridges containing programs and additional memory.

It had been hoped that the VIC-20 and TI 99/4A would battle it out so that we would have a clear champion. Now there are two major newcomers to the class that promise to give the leaders a real run for the money. On one hand, we have the Timex Sinclair 2000 (called Spectrum in Europe), a British challenger, kin to the TS1000 (featherweight

champ). As was the case with its predecessor, the TS2000 has spent over a year training in England for its American debut. On the other hand, we have a homegrown product out of Hawthorne, California, with the jazzy moniker, Aquarius™. It arrives on the scene as a virtual unknown to the microcomputer fraternity, but is backed by the powerful Mattel Electronics family. Both entrants are highly regarded and appear genuine threats to ascend to division supremacy. Let's examine each one's qualifications.

Timex Sinclair 2000. Like Ingemar Johanssen, the Swede with the knockout right, the TS2000 arrives on these shores packing "thunder and lightning" in the form of a 48K RAM memory standard for the $199.95 suggested list price. This is at least 32K more than other computers in this class offer in their standard package. This is just the beginning of a set of statistics so impressive that you'll think this computer is a ringer for sure.

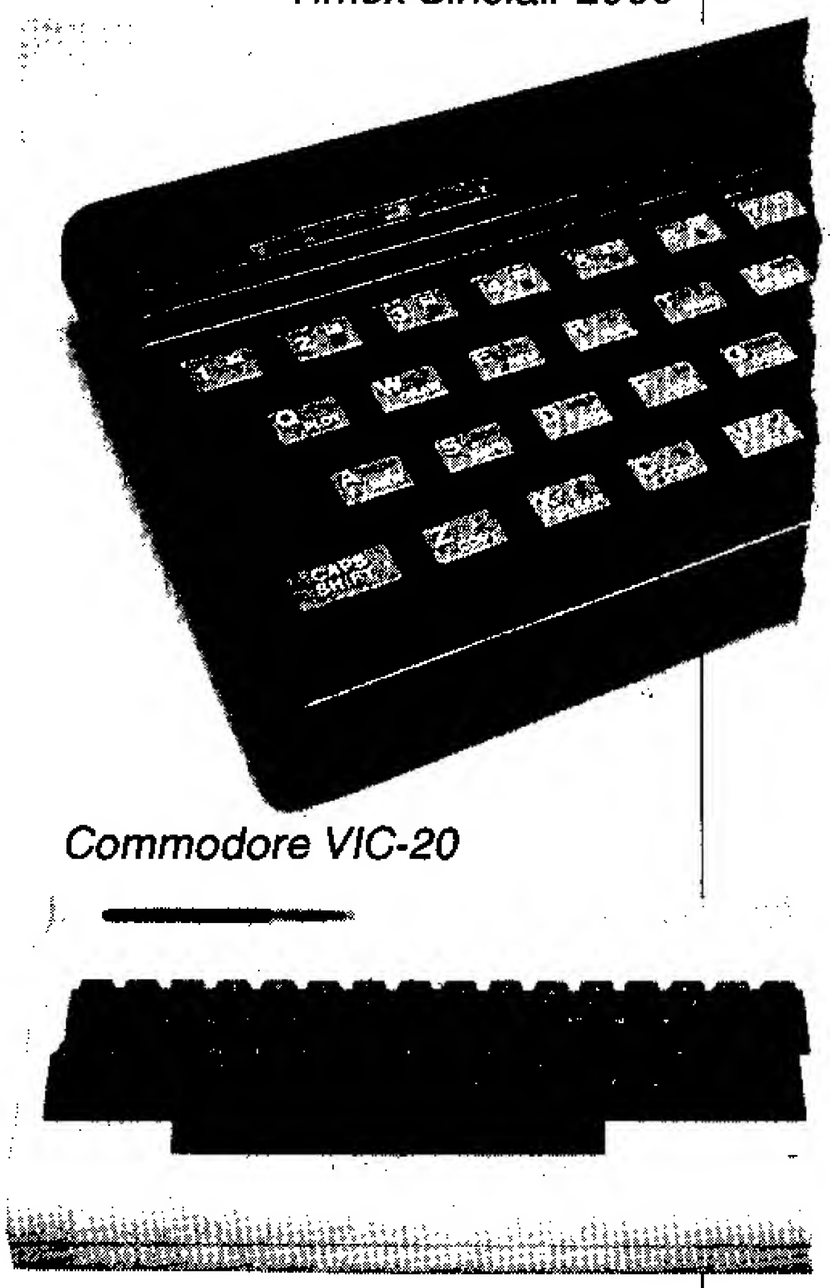
Talk about color and it's there. Blue, red, magenta, green, cyan, yellow, white, and black are available for foreground, background, and border areas at the press of a single key. Talk about sound and you've got that, too. An internal loudspeaker can emit 130 semitones (10 octaves) using a BEEP command. Since pitch and duration can be varied, selections such as "Rocky's Theme" can be composed at the keyboard. You can even run the sound to an external amplifier/speaker from jacks at the rear of the unit.

The machine is compact, measuring 9⅛" × 5⅝" × 1¼". This is attributable to the TS2000's elegant 14-chip design. Besides the 48K RAM, there is a 16K ROM that contains the operating system and a BASIC interpreter. The extended BASIC has a unique syntax check-and-report feature that identifies mistakes instantly. The heart of the TS2000 is the Z80A microprocessor running at 3.5 MHz.

The keyboard features 40 rubber pushbutton keys in a standard typewriter format. But you'll need some fancy footwork (fingerwork?) to hit all the options available here. Each key provides at least five functions, while six keys provide six each. All BASIC keywords can be entered with a single keystroke; and, in addition, there are 16 graphics characters, 22 color control codes, and 21 user-definable graphics characters. Both upper- and lower-case letters are supported, and all keys feature auto repeat. A close look at this intricate keyboard will give the ringsider an indication of the championship quality of this computer.

The TS2000 has a memory-mapped video display of 256 × 192 pixels, giving quality high-resolution graphics. The text display is 24 lines of 32 charcters. Both can be freely mixed on the screen. Graphics commands such as point, line, and circle are available at the touch of a key. Editing functions such as cursor left, cursor right, insert, and delete are available for the program line currently being edited. This line(s) normally resides at the bottom two lines of the 24-line display.

Timex Sinclair 2000

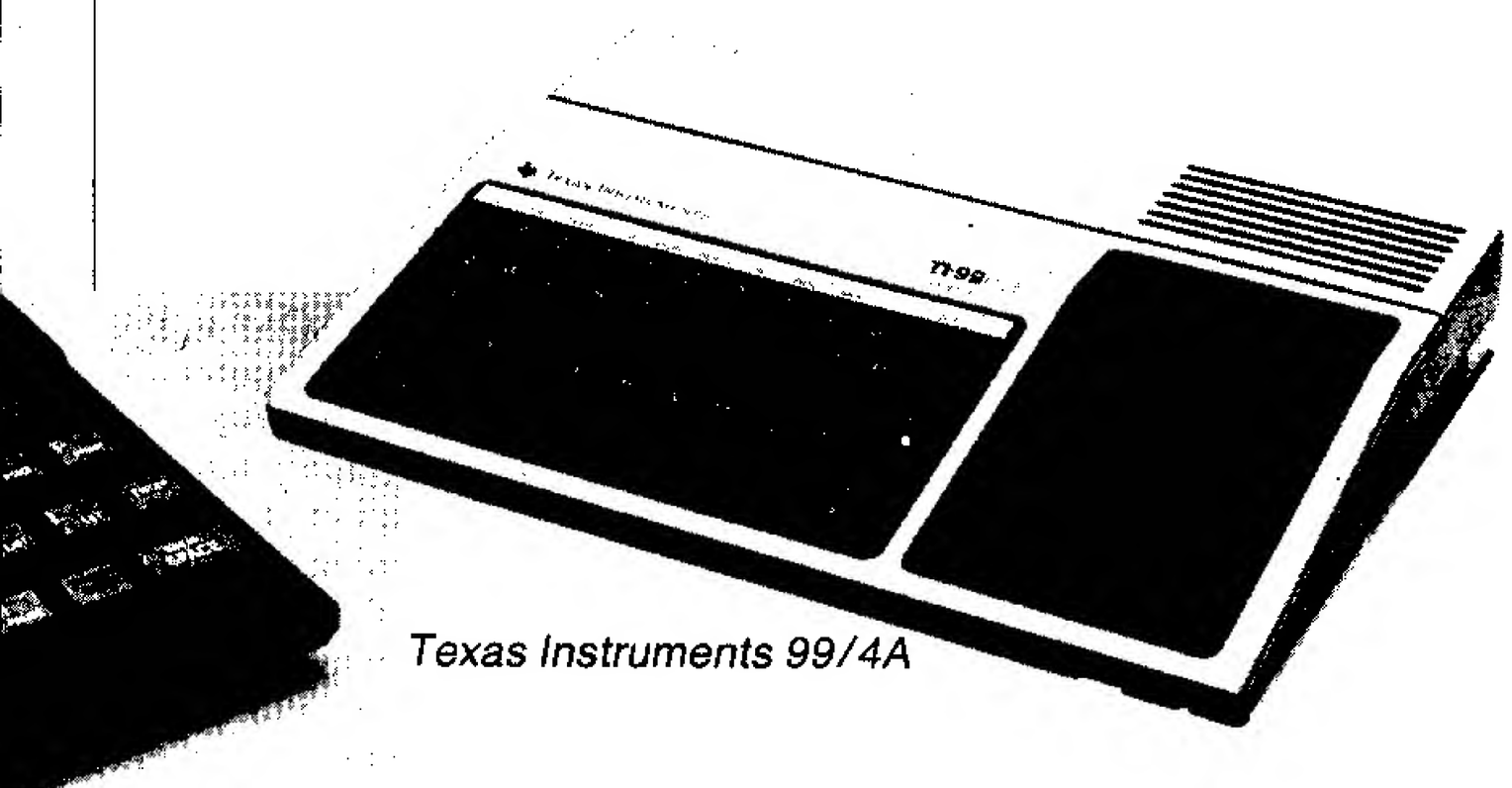


Commodore VIC-20

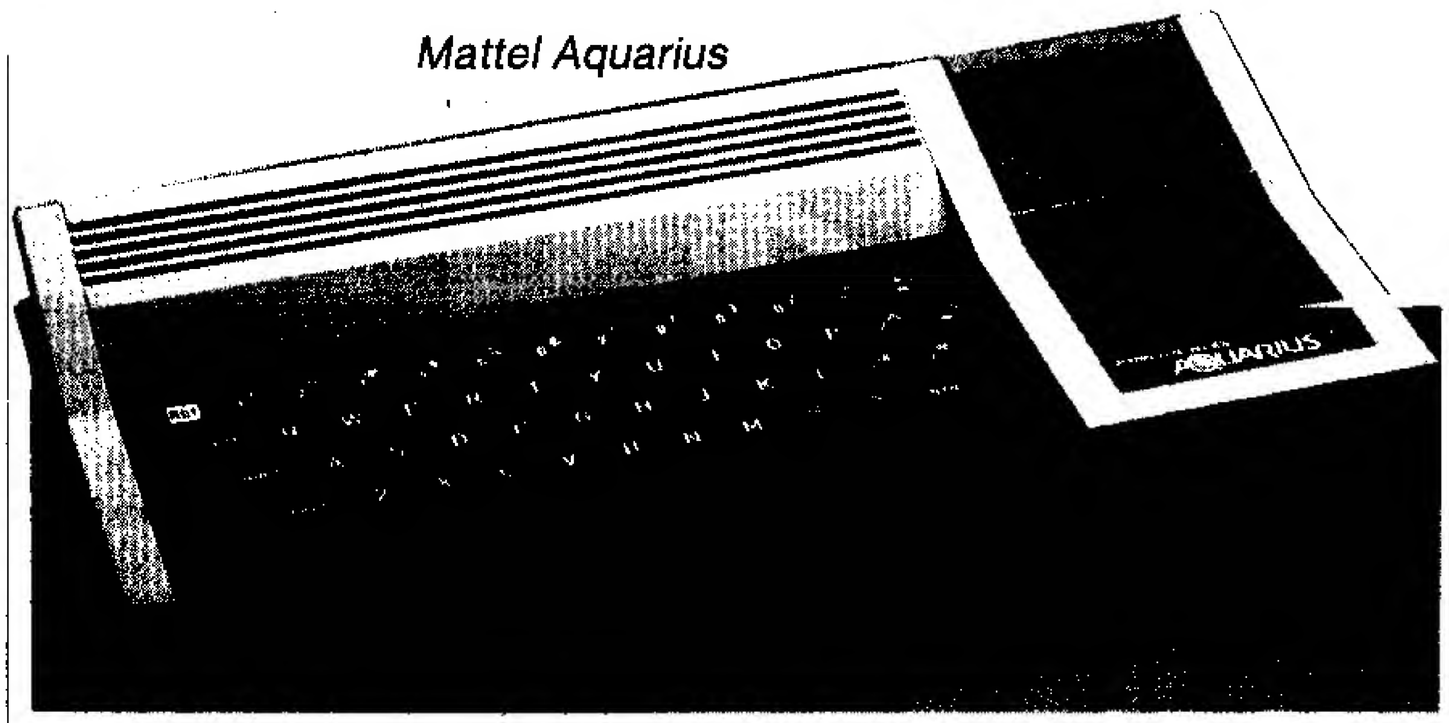
The unit has a built-in r-f modulator and cassette interface. The cassette interface, which runs at 1500 baud, can load or save 48K of memory in less than two minutes. All information saved to tape is started with a header containing information as to its type, title, length, and address information. Programs, screens, blocks of memory, and string and character arrays can all be saved separately, as well as verified if desired. Programs and arrays

LIGHTWEIGHTS AT A GLANCE

	Commodore VIC-20	Texas Instruments 99/4A	Timex Sinclair 2000	Mattel Aquarius
Microprocessor	6502A (2 MHz, 8 bit)	TMS 9900 (3 MHz, 16 bit)	Z80A (3.5 MHz, 8 bits)	Z80A (3.5 MHz, 8 bits)
Resident language	Microsoft BASIC	T1 BASIC	Sinclair Extended BASIC	Microsoft BASIC
Memory: ROM	20K	26K	16K	8K
RAM (Std)	5K	16K	48K	4K
RAM (Exp)	32K	48K	48K	52K
Display: Text	22 char. × 23 lines	32 char. × 24 lines	32 char. × 24 lines	40 char. × 24 lines
HiRes Graphics	176 × 184 pixels	192 × 256 pixels	192 × 256 pixels	192 × 320 pixels
Keyboard	66 keys (typewriter quality)	48 keys (typewriter quality)	40 keys (movable)	49 keys (movable)
Colors	16	16	8	16
Sound	4 voices	3 voices & 1 sp. eff.	1 voice	1 voice
Dimensions	15¾" × 8" × 2¾"	15" × 10⅛" × 2¼"	9⅛" × 5⅝" × 1¼"	13" × 6" × 2"
Weight	72 oz	78 oz	20 oz	68 oz



Texas Instruments 99/4A



Mattel Aquarius

can be merged from tape with existing contents of memory, but if line numbers or variable names are repeated, the one in memory is overwritten.

There is an expansion port at the rear of the TS2000 that has the full data, address and control busses from the Z80A. Solid-state software cartridges plug right into this port. The port is also used for plug-in peripherals such as the Timex-Sinclair 2040, a 32-column dot-matrix printer for $99.95. IN and OUT commands give the I/O port equivalents of PEEK and POKE.

To help fans become better acquainted with the TS2000, a comprehensive step-by-step instruction manual is included. It is divided into two parts. The first part contains complete instructions on setting up and using the computer, and includes a fundamental course in BASIC programming. The second part includes an advanced programming guide for experienced users to develop custom applications.

Sinclair is commited to the introduction of a ZX Expansion Module that will direct and control its new microdisk drive. This module will permit TS2000 computers to communicate with each other and to interface with many commercial printers. In addition, it will permit the connection of a modem for communication over the telephone line. The microdisk itself will store 100K bytes per disk and the TS2000 will support up to eight drives. These peripherals will be offered in the U.K. in the spring of 1983 and they should be available from Timex in the U.S. shortly after that time. The introduction of a disk system and the expansion module will greatly enhance the position of the TS2000 in its fight to the top.

Mattel Aquarius. This contender for honors in the lightweight division appears to be just a 98-pound weakling at first glance. It is a modest (13″ × 6″ × 2″) unit with an unassuming keyboard. A total of 49 light-blue, pushbutton keys with one letter per key makes one wonder whether this is a computer or a Tom Thumb typewriter. But beware the feint and jab, and the old peek-a-boo. With one or another overlay, the keyboard is immediately transformed to match a particular computing need.

If you're programming, keywords are indicated for one-stroke entry. If you're playing a game, up and down, right and left indicators are shown. If you're running a word-processing program, commands such as insert and delete make the task a snap. What we really have, then, is a keyboard that is simple yet powerful. Granted, the keys are not the classiest, but first-time users will not be intimidated either.

The standard Aquarius comes with 4K RAM, expandable to 52K, and 8K ROM that includes Microsoft™ BASIC. The system can be expanded to use plug-in-memory cartridges, expansion devices, and a whole line of compatible peripherals. CP/M® is available when the system is expanded enough to support it.

Aquarius offers a 320 × 192 high-resolution graphics display and a 40 character × 24 line text display. There are 256 total characters, which include the complete ASCII set with upper- and lower-case letters, numbers, and graphics symbols. Sixteen colors are available. A built-in r-f modulator is standard, as well as an RS232 port. Sound can be generated, but only through the speaker on a television receiver.

The real strength of this contender lies in the meaningful software support that Mattel has provided. Three programs, Aquarius LOGO, Fileform, and Finform offer sophisticated software at a reasonable price. LOGO is a popular graphics-oriented language that helps develop problem-solving skills. (LOGO is available on the TI 99/4A, too, but costs several hundred dollars to implement.)

Fileform is a combination file management and word-processing program. The file management features enable you to store and retrieve information such as addresses, phone numbers, correspondence, etc. Word-processing fea-

tures enable you to insert, delete, move blocks of copy, etc.

Finform is the Aquarius version of a spreadsheet program. It has a capacity of 63 columns and 255 rows, and can perform the usual "what if?" operations. Just change a value in one of its cells and the program recalculates all values instantly.

Mattel Electronics has provided an ingenious multi-step system for expanding the Aquarius. First you can plug memory modules of either 4K or 16K capacity directly into the cartridge slot on the computer. Though increasing memory capacity, it does not let you run software cartridges because the cartridge slot is filled. To get around this problem, Mattel has provided the Mini Expander Module. This peripheral has two slots, one for either a 4K or 16K memory module and the other for a software cartridge. In addition, the Mini Expander has two detachable game controllers with six pushbuttons and a 16-position control disk such as that used on the Mattel Intellivision. The Mini Expander also provides three full sound channels for audio effects.

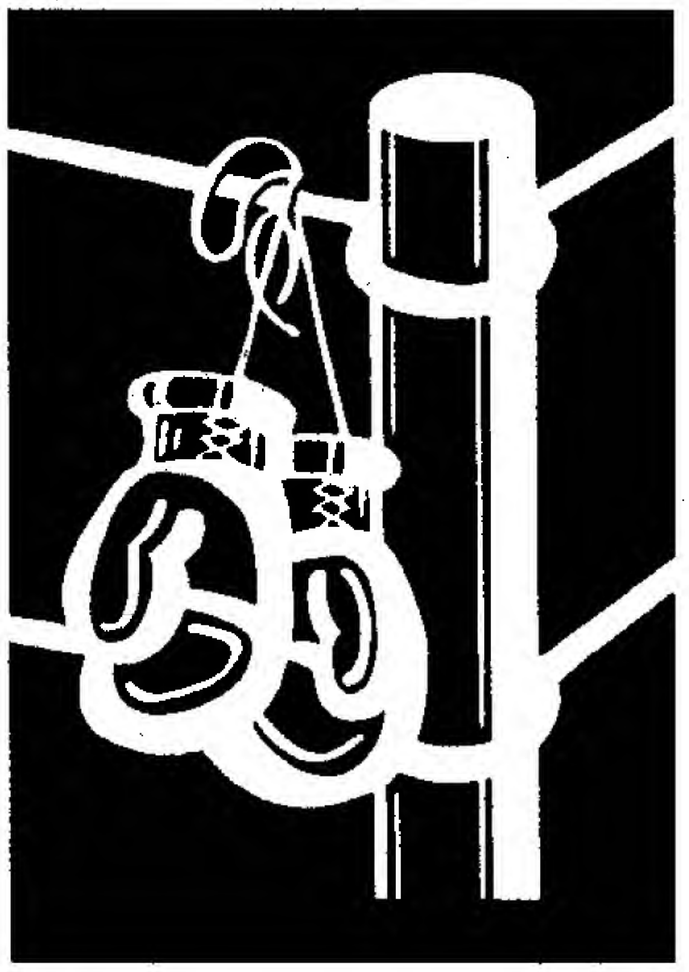
The third level of Aquarius expansion is the Master Expansion Module. This has provisions for 16K memory boards and a disk controller that operates two floppy disk drives. When the Aquarius is fully expanded, it can use CP/M; and the conversion from a starter system to a powerful personal computer is complete.

Mattel Electronics has also provided a cassette Data Recorder unit and a dot matrix printer that will print anything that appears on the screen, including graphics. This is a non-impact printer and requires thermal paper. It prints up to 40 columns and includes upper/lowercase characters and all the Aquarius graphics characters.

Unfortunately, game cartridges for Mattel's Intellivision are not compatible with Aquarius, although a selection of video games is available for the computer.

There are two manuals that come with Aquarius. One is a standard manual that describes the system and how to use it. The other is meant to get a person into programming immediately. Each page is like a flash card, with simple instructions to perform a specific action. A particular card may give a short program to display various colors on the screen. The goal here is to make a novice's transition into computing as painless as possible.

Our Opinion. Each of the two new entrants to the microcomputer lightweight division (between $100 and $200) has a unique style. The Timex Sinclair 2000 offers raw power, and indeed looks like a monster



entry to us. If the computer had a professional keyboard, there would be no doubt that it would sweep the division with ease. Even so, we predict that this computer shows enough to send it skyrocketing to the top of the division within a year. In this case, it's likely that the Commodore VIC 20 and the TI 99/4A will go into the sweatbox and lower their prices enough to qualify for the under $100 featherweight division. After all, the big bucks are in the peripherals and software.

The Aquarius offers simplicity rather than power although the system can be expanded and good software is available. But overall we think that the Aquarius strategy of strength through simplicity will not be enough to make it the dominant micro in this division, though such a good contender will likely gather a significant following.

Up and Coming. What's on the horizon in the featherweight and lightweight divisions? There are two novices that have been training well and are expected to take a shot at the big time this year. One is the PHC 20 Personal Computer, a $99.95 model from Sanyo that was introduced at a recent industry show. But the backers of this Japanese performer have been somewhat secretive since the show, so we'll have to wait and see what develops.

Another interesting candidate is the Humdinger color computer (Venture Micro, Inc., 10090 N. Blaney Ave. Suite #6, Cupertino, CA 95014). With a suggested retail of $129.95 and impressive stats, too, this exciting youngster was the hit of the 1983 West Coast Computer Faire. The Humdinger, although talent laden, will need to find a well-heeled backer to handle promotions before it can be considered a serious threat in the pro ranks.

There are other computers around that fit into the price classes suggested here, but for one reason or another have not been considered. First, there are the pocket computers from Sharp Electronics and Radio Shack. The new Sharp 1250, nicknamed the "Student Computer," and the Radio Shack PC-4 have suggested retail prices of $110 and $69.95, respectively. These models offer increased portability at the cost of decreased expandability and are not really in the same class as the models that were described here.

A second set of opponents at the low end of the personal computer spectrum are the "tag team" models. These are the micros that consist of a keyboard connected to a video game such as the Atari 2600 or Mattel Intellevision. Although the expansion unit falls into the price range of the micros discussed here, the total cost of the package is usually above $200.

This wraps up our report on the micros battling for supremacy in the low end of the personal computer market. It's obvious that the divisions we've covered here are very competitive and will provide much excitement as each entrant follows Rocky's advice to "go for it" in coming months. ◇